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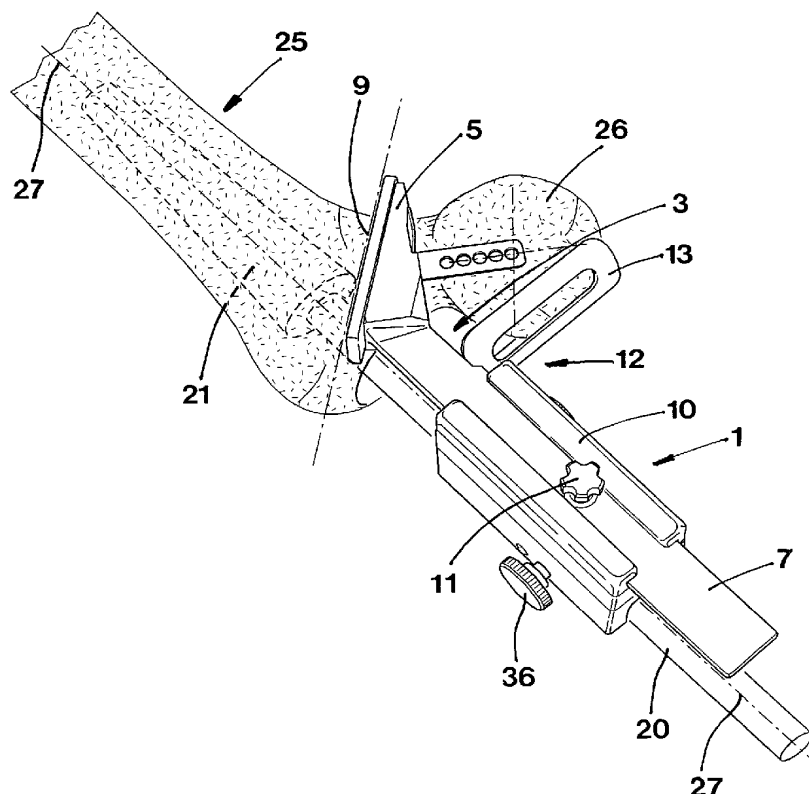
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[Continued on next page]

(54) Title: GUIDING INSTRUMENT FOR THE RESECTION OF A FEMORAL NECK



(57) Abstract: The present invention relates to a guiding instrument for the resection of a femoral neck (25; 25") in connection with total hip replacement, said guiding instrument comprising an instrument body (1; 1") having means for receiving a shank (20; 20") or the like that is mounted in the medullary canal of the femoral neck (25; 25"), said shank (20; 20") having a longitudinal centre axis (27; 27"), the instrument body (1; 1") being displaceable along said shank (20; 20"), and a guiding means (5; 5'; 5") having a guiding arrangement (9; 9") for the means that perform cutting of the femoral neck. Significant for the guiding instrument according to the present invention is that at least a rotation ruler (12; 12"a, 12"b) is attached to the instrument body (1; 1"), said rotation ruler (12; 12"a, 12"b) being intended to cooperate with the existing femoral head (26; 26") of the femur (25; 25").



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**GUIDING INSTRUMENT FOR THE RESECTION OF A FEMORAL NECK****Technical Field of the Invention**

The present invention relates to a guiding instrument  
5 for the resection of a femoral neck in connection with total  
hip replacement, said guiding instrument comprising an  
instrument body having means for receiving a shank or the like  
that is mounted in the medullary canal of the femoral neck,  
said shank having a longitudinal centre axis, the instrument  
10 body being displaceable along said shank, and a guiding means  
having a guiding surface for the means that performs cutting  
of the femoral neck.

**Prior Art**

15 A device in the shape of a guide for resecting the  
femoral neck of a patient is previously known from  
US-A-5,578,037, said patient being about to receive a  
prosthesis having an artificial femoral head. The device  
comprises a shank that is mounted in the medullary canal of  
20 the femur of the patient. In order to achieve a correct  
position of the guide it is necessary to know the distance, in  
longitudinal direction of the femur, between the upper end of  
the femoral neck and the centre of the femoral head. An X-ray  
picture gives information about this distance and it is at  
25 once realised that this could provide a source of error, e.g.  
due to unclear X-ray pictures or incorrect readings. A  
further disadvantage of the device according to US-A-5,570,037  
is that the rotational orientation, relative to the  
longitudinal axis of the femur, is not determined. This might  
30 cause the resected surface of the femur to achieve such an  
orientation that the patient is marked for life subsequent to  
the executed total hip replacement.

**Objects and Features of the Invention**

35 A primary object of the present invention is to present  
a guiding instrument according to the present invention, by  
means of which instrument a cutting surface is provided in  
connection with the resection of the femur, said cutting  
surface being correctly oriented relative to the femoral head

of the patient, said femoral head being removed in connection with said resection.

A further object of the present invention is to have a setting of the instrument that is as correct as possible, this  
5 being achieved by having the guiding instrument to cooperate with the genuine parts of the hip joint.

Still an object of the present invention is that the elements of the guiding instrument also should give information about the size of the prosthesis that is to be  
10 mounted.

At least the primary object of the present invention is realised by means of a guiding instrument that has been given the features of the appended independent claim. Preferred embodiments of the invention are defined in the independent  
15 claims.

### **Brief Description of the Drawings**

Below embodiments of the guiding instrument according to the present invention will be described, reference being made  
20 to the accompanying drawings, where:

Figure 1 shows a perspective view of the guiding instrument according to the present invention;

Figure 2 shows a first perspective view where the guiding instrument according to the present invention is  
25 attached to a femur;

Figure 3 shows in perspective view a number of gauges incorporated in the guiding instrument;

Figure 4 shows a second perspective view where the guiding instrument according to the present invention is  
30 attached to a femur;

Figure 5 shows a side view of a hip joint prosthesis that is equipped with a detachable femoral head;

Figure 6 shows an end view of the hip joint prosthesis according to figure 5, however without the femoral  
35 head;

Figure 7 shows a side view of a femur that is equipped with the hip joint prosthesis according to figure 5;

Figure 8 shows an alternative embodiment of a guiding element incorporated in the guiding instrument according to the present invention; and

Figure 9 shows an alternative embodiment of a guiding instrument according to the present invention.

#### **Detailed Description of Preferred Embodiments of the Present Invention**

In figures 1, 2 and 4 a guiding instrument according to the present invention is shown, said guiding instrument comprising an instrument body 1, which on one side has a guiding element 3 that in its turn comprises a guiding means 5 and a guiding bar 7 connected to the guiding means 5. The guiding means 5 is provided with a guiding surface 9 that is located on the side of the guiding means 5 that faces away from the guiding bar 7. The guiding surface 9 has a certain inclination relative to the longitudinal direction of the guiding bar 7. The instrument body 1 is also equipped with a grooved guiding 10 that slidably receives the guiding bar 7, this being indicated by the first double arrow 8 in figure 2. The guiding bar 7 is equipped with a first locking screw 11, by means of which the guiding bar 7 may be locked in an arbitrary position in the guiding 10.

The instrument body 1 of the guiding instrument according to the present invention is also equipped with a rotation ruler 12 comprising a guiding cup 13 and a blade-shaped shank 14 that is connected to the guiding cup 13 and being equipped with a number of first holes 15 that each may receive a second locking screw 16. The instrument body 1 also has a recess 17, in which the blade-shaped shank 14 is intended to be received, said recess being equipped with a number of threaded second holes 18 each intended to receive a second locking screw 16. As is evident from figures 1 and 2 the blade-shaped shank 14 is mounted in the recess 17 and then the blade-shaped shank 14 is fixed in suitable position by having the second locking screw going through a first hole 15 and being received in a second hole 18. Which first hole 15 of the shank 14 that will be chosen, i.e. how far the shank 14

is projecting from the instrument body 1, depends on the anatomy of the patient that is operated.

In this connection it should be pointed out that it is possible to use the guiding instrument according to the present invention in connection with resection of the femoral neck at both the right side and the left side of the patient. To rearrange the instrument both the guiding bar 7 and the shank 14 is turned around, see figure 1, to have them pointing in a direction to the left in figure 1. Then the guiding bar 7 is locked in the guiding 10 and the shank 14 is fixed in the recess 17 of the instrument body 1 in their respective turned around positions.

The guiding instrument according to the present invention also comprises a notch 19 on the side opposite to the guiding 10. In said notch 19 a shank 20 of a reamer 21 may be received, said reamer 21 may form a part of the guiding instrument. Said reamer 21 constitutes a conical body that preferably is equipped with exterior rifles. How the reamer 21 with its shank 20 is mounted in the notch 19 is evident from figures 2 and 4. The third locking screw 36, shown in figure 4, locks the shank 20 of the reamer 21 in the notch 19 since the second holes 18 are through going. The function of the reamer 21 will be evident from below in connection with the description of the method according to the present invention. Thus, the reamer 21 may constitute a part of the guiding instrument according to the present invention, i.e. it is especially designed for said guiding instrument, alternatively the guiding instrument according to the present invention may also be used with other reamers present on the market.

The embodiment, disclosed in the figures, of the guiding instrument according to the present invention also comprises a number of gauges 22 that are shown separately in figure 3. Said gauges 22 being in the shape of sheet tin plates that have two portions perpendicular to each other, i.e. one indicating portion 23 and one fastening portion 24. As is evident from figures 1-4 the indicating portion 23 is provided with a number of holes 25. In figure 2 it is shown how a gauge 22 is attached on the side of the guiding means 5 that

faces away from the guiding surface 9. Preferably, the guiding means 5 is magnetic and the gauge 22 is manufactured from sheet metal. Therefore, the fastening portion 24 adheres to the guiding means in arbitrary position. The function of the gauge 22 will be described more in detail below.

When using the guiding instrument according to the present invention in connection with total hip replacement the following way of action is followed. A femur 25 that will be subjected to total hip replacement is shown in figures 2 and 4, said femur 25 in a conventional way having an internal medullary canal for fastening of the prosthesis and a femoral head 26. In connection with total hip replacement the soft medullary is removed from the medullary canal with the use of different reamers and draw broaches. In connection therewith the reamers are used initially, said reamers being symmetrical and being rotated, and thereafter the draw broaches are used, said draw broaches being non-symmetric and giving the medullary canal a shape that corresponds to the shape of the stem of the prosthesis. This will be explained more in detail below.

When the reamer 21 has removed the soft medullary and if necessary widened the medullary canal the reamer 21 is left in the medullary canal. A common longitudinal centre axis of the medullary canal, the reamer 21 and the shank 20 is designated by 27. Then the guiding instrument according to the present invention is mounted on the shank 20 of the reamer 21. The shank 20 is received in the recess 19 and the guiding instrument may be displaced in the longitudinal direction of the shank 20 and also rotated relative to the shank 20, see the second double arrow 28, the centre of rotation of the guiding instrument coinciding with the centre axis 27. When the guiding instrument is positioned in a correct way, i.e. the guiding cup 13 is abutting the femoral head 26 the instrument body 1 is fixed relative to the shank 20 by means of a third locking screw 36 that is located on the opposite side of the instrument body 1 relative to the rotational ruler/the guiding cup 12.

In order to choose the most correct prosthesis it is necessary to locate the centre of rotation of the femoral head

26, this being effected in the way that is illustrated in figure 2. In connection therewith the guiding bar 7 of the guiding means 5 is displaced in the guiding 10, a gauge 22 being attached to the guiding means 5 in the way that is shown  
5 in figure 2. By displacing the guiding means 5 in the guiding 10 the indicating portion 23 of the gauge 22, said portion 23 being equipped with holes 25, will pass the femoral head 26 and by ocular inspection it is decided whether any hole 25 of the gauge 22 coincides with the centre of rotation of the  
10 femoral head 26. If this is the case the guiding bar 7 is locked in the guiding 10 in the position where a hole 25 coincides with the centre of rotation of the femoral head 26, whereafter a suitable prosthesis may be chosen since the gauge in combination with a certain hole 25 corresponds to a certain  
15 prosthesis. If it is ruled that none of the holes 25 of the gauge 22 coincides with the centre of rotation of the femoral head 26 the gauge 22 is exchanged and replaced by another gauge that is estimated to suit in a better way.

When the guiding bar 7 and hence also the guiding means  
20 5 are fixed relative to the guiding 10 of the instrument body 1 the resection of the femur 25 may take place, this being effected by means of a special saw (not shown), said saw during the initial phase of the resection being brought to contact the guiding surface 9. The special saw is design in  
25 such a way that it may perform saw cuts in the femur 25 at one side of the reamer 21 that remains in the medullary canal of the femur 25, see figure 4. When this is finished the reamer 21 is removed and hence also the guiding instrument according to the present invention. The resection of the femur 25 is  
30 now completed and the existing cut serves as guiding for the saw in connection with the remaining sawing. Thereby a saw cut is achieved that in principle is in the same plane as the guiding surface 9 of the guiding means 5. In this connection it should be pointed out that the guiding instrument pays  
35 regard to the material of the femur that disappears in connection with the resection, i.e. the width of the saw cut. By the resection a cutting surface 29 of the femur 25 is created, see figure 7.



In figure 5 a prosthesis 30 having a detachable femoral head 31 is shown and in figure 6 the prosthesis 30 according to figure 5 is shown without its femoral head. The end 32 of the prosthesis 30 that is intended to receive the artificial femoral head 31 is slightly conical, the femoral head 31 having a mutually conical recess 33 that in mounted position of the femoral head 31 receives the conical end 32. The actual mounting may be effected by forcefully urging or hitting the femoral head 31 on to the conical end 32. Preferably the cone angle is so small that it is self-braking. Which femoral head 31 that is chosen depends on the information that this given from the gauge 22 that has been found to be most correct when adjusting the guiding means 5. The portion of the prosthesis 30 that faces away from the conical end 32, i.e. the stem 34, has a somewhat flattened shape, this being realised by simultaneously studying figures 5 and 6.

Before the prosthesis 30 is mounted in the resected femur 25 the medullary canal is worked by means of a draw broach (not shown), the medullary canal being given a shape, i.e. somewhat flattened, that corresponds to the shape of the stem 34 of the prosthesis 30. This flattened, cooperating shape of the medullary canal and the stem 34 is prosperous to prevent the stem 34 from rotating when it is mounted in the medullary canal.

In figure 7 is shown how the prosthesis 30 is mounted in the femur 25, an abutment surface 35 of the prosthesis 30, located between the conical end 32 and the stem 34, will contact the cutting surface 29 of the femur 25. By using a guiding instrument according to the present invention it is guaranteed, with a relatively high accuracy, that the centre of rotation of the artificial femoral head 31 coincides with the centre of rotation of the removed femoral head 26. By studying the figures it is realised that the removed femoral head 26 has an essentially larger diameter than the artificial femoral head 31. The explanation thereto is that the artificial femoral head 31 always is used together with an artificial bowl (not shown) that is attached to the existing

femoral bowl, said artificial bowl having a transverse dimension that is essentially smaller than the existing bowl.

The alternative embodiment, shown in figure 8, of a guiding element 3' according to the present invention  
5 comprises a guiding means 5' and a guiding bar 7', the guiding means 5' and the guiding bar 7' being detachably connected to each other by means of a screw 37' or the like. The guiding means 5' is equipped with a number of through going holes 38' that extend perpendicular to the plane that the guiding bar 7'  
10 is located in. The guiding means 5' also has a recess 39' that is intended to receive the fastening portion 24 of a gauge 22. The guiding element 3' according to figure 8 is not only assisting in connection with the actual resection of the femoral head but also in connection with the subsequent  
15 anchoring of the prosthesis in the resected femoral neck.

When using the guiding element 3' according to figure 8 the following way of action is followed. In a corresponding way as for the guiding element 3 the guiding bar 7' is brought to be received and fixed in the guiding 10. When a suitable  
20 prosthesis has been chosen, e.g. by the aid of a certain gauge that is located in the recess 39', the guiding means 5' is fixed to the femur by means of a number of boring pins (not shown), said boring pins going through the guiding means and being anchored in the femur. The boring pins are preferably  
25 mounted by means of a boring machine. When the guiding means 5' in a proper way is fixed to the femur the screw 37' is removed and the guiding bar 7' is dismantled from the guiding means 5'. Then the rest of the instrument may be removed, except for the guiding means 5', that is fixed to the femur.  
30 The resection of the femur now takes place and the guiding surface 9' of the guiding means 5' serves as a guiding for the saw blade. By this arrangement the guiding means 5' will remain on the femur even after resection. If there is a need, further reaming of the medullary canal may take place before  
35 the prosthesis is mounted. In connection with mounting of the prosthesis in the medullary canal the chosen gauge 22 again is located in the recess 39' and it may be checked that the centre of rotation of the femoral head of the prosthesis coincides with the position of the centre of rotation of the

resected femoral head. The prosthesis is maintained in this position while the cement that is supplied to the medullary canal is allowed to harden. It is checked that the prosthesis is located in the middle of the reamed medullary canal and  
5 that the cement is uniformly distributed around the prosthesis.

In figure 9 an alternative embodiment of the guiding instrument according to the present invention is shown. The most essential difference compared to the embodiment described  
10 above is that the guiding instrument according to figure 9 has two rotation rulers 12"a, 12"b, each having a guiding cup 13". The guiding cups 13" are fixed to an instrument body 1", more precisely at opposite ends of the instrument body 1". In a corresponding way as in connection with the embodiment  
15 described above the instrument body 1" has a longitudinal guiding (not shown in detail), in which a guiding bar 7" of a guiding element 3" is received. A first locking screw 11" is attached to the instrument body 1" and the guiding bar 7" may be fixed in arbitrary position in the guiding by means of the  
20 first locking screw 11". As is evident from figure 9 the guiding element 3" has a guiding means 5" that is equipped with a guiding groove 9 that has a certain inclination relative to the longitudinal direction of the guiding bar 7". A special saw (not shown) is mounted in said guiding groove  
25 9", said special saw effecting resection of the femur 25" when the guiding bar 7" is in correct position relative to the instrument body 1".

In a corresponding way as for the embodiment described above the instrument body 1" has a longitudinal recess (not  
30 shown in detail), in which a shank 20" of a reamer 21" may be received. The instrument body 1" has a second locking screw 16", by which the shank 20" may be fixed in an arbitrary position in the longitudinal recess.

The guiding means 5" is also equipped with an anchoring  
35 groove 40" for a gauge 22" that has an indicating portion 23" and a fastening portion 24" that preferably is held in the anchoring groove 40" by means of a magnetic force. By the aid of the gauge 22" a suitable prosthesis is chosen when a certain hole of the indicating portion 23" is brought to

coincide with the centre of rotation of the femoral head 26". As is evident from figure 9 the anchoring groove 40" is equipped with a step 41" along one edge, the fastening portion 24" of the gauge 22" having a complementary step. By this arrangement the fastening portion 24" of the gauge 22" may only be mounted in one given position in the anchoring groove 40". Hence the risk of mounting the gauge 22" in an incorrect position is eliminated. The gauge 22" may be used both for the right hip joint and the left hip joint.

When using the guiding instrument according to figure 9 the lower guiding bowl 12"a is used for the right hip joint while the upper guiding bowl 12"b is used for the left hip joint. When shifting between the hip joints the guiding means 5" must be detached and turned endwise.

In this connection it should also be mentioned that the attachment of an artificial bowl could bring the centre of rotation of the artificial femoral head to be displaced a few mm upwards, in direction towards the head of the patient, in respect to the centre of rotation of the removed femoral head. The above described gauges 22; 22" may be designed in such a way that they compensate for this displacement of the centre of rotation of the artificial femoral head.

### **Feasible Modifications of the Invention**

In the description above, in connection with figures 1-7, a prosthesis having a detachable femoral head has been used, said femoral head being mounted on the prosthesis before said prosthesis is fixed in the resected femur 25. However, the guiding instrument according to the invention may be used in connection with a prosthesis having both a detachable femoral head and a fixed femoral head.

As regards the prostheses that are used further modifications are feasible. Thus the prosthesis may be void of the abutment surface that is intended to contact the cutting surface of the femur. Instead the prosthesis normally has other indicating means, e.g. a number of dots arranged on the circumference of the stem of the prosthesis, said points assisting in the judgement regarding the displacement of the prosthesis into the resected femur.

**Claims**

1. Guiding instrument for the resection of a femoral neck (25; 25") in connection with total hip replacement, said  
5 guiding instrument comprising an instrument body (1; 1")  
having means for receiving a shank (20; 20") or the like that  
is mounted in the medullary canal of the femoral neck (25;  
25"), said shank (20; 20") having a longitudinal centre axis  
(27; 27"), the instrument body (1; 1") being displaceable along  
10 said shank (20; 20"), and a guiding means (5; 5'; 5") having a  
guiding arrangement (9; 9") for the means that perform cutting  
of the femoral neck, c h a r a c t e r i z e d in at least  
one rotation ruler (12; 12"a, 12"b) attached to the instrument  
body (1; 1"), said rotation ruler (12; 12"a, 12"b) being  
15 intended to cooperate with the existing femoral head (26; 26")  
of the femur (25; 25").

2. Guiding instrument according to claim 1,  
c h a r a c t e r i z e d in that the rotation ruler (12;  
20 12"a, 12"b) comprises a guiding bowl (13; 13") that is  
intended to be brought into contact with the existing femoral  
head (26; 26").

3. Guiding instrument according to claim 1 or 2,  
25 c h a r a c t e r i z e d in that the instrument body (1")  
has two rotation rulers (12"a, 12"b) that are fixed to the  
instrument body (1").

4. Guiding instrument according to any of the previous  
30 claims, c h a r a c t e r i z e d in that the guiding means  
(5; 5'; 5") is displaceable in direction of the longitudinal  
centre axis (27; 27").

5. Guiding instrument according to claim 4,  
35 c h a r a c t e r i z e d in that gauges (22; 22") may be  
attached to the guiding means (5; 5'; 5"), said gauges (22;  
22") positioning the guiding means (5; 5'; 5") in direction of  
the longitudinal centre axis (27; 27").

6. Guiding instrument according to claim 5,  
c h a r a c t e r i z e d in that the gauges (22") are  
received in a fastening groove of the guiding means (5").

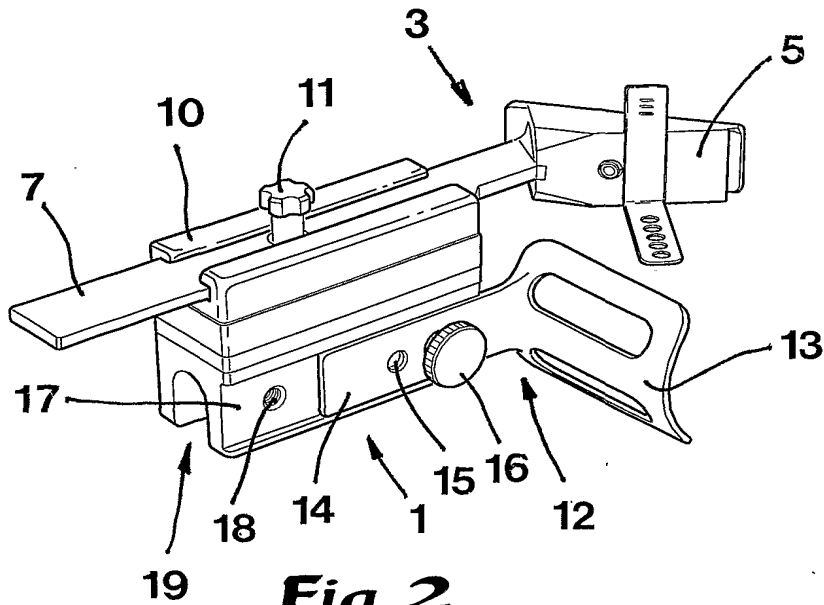
5 7. Guiding instrument according to any of claims 1-6,  
c h a r a c t e r i z e d in that the guiding means (5; 5';  
5") is incorporated in a guiding element (3; 3'; 3"), said  
element also comprising a guiding bar (7; 7'; 7") that is  
slidingly received in a guiding (10) on the instrument body  
10 (1; 1").

8. Guiding instrument according to any of the previous  
claims, c h a r a c t e r i z e d in that the instrument body  
(1; 1") has a recess (19), in which the shank (20; 20") is  
15 received.

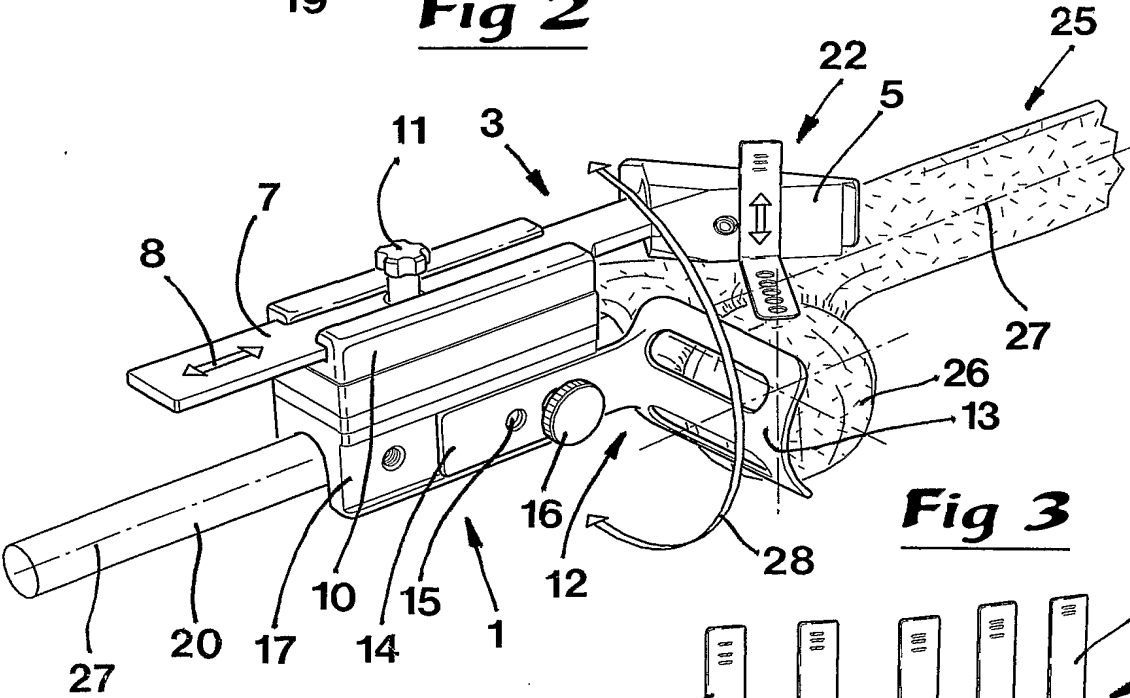
9. Guiding instrument according to claim 7,  
c h a r a c t e r i z e d in that the guiding means (5') and  
the guiding bar (7') are detachably connected to each other.  
20

10. Guiding instrument according to any of the previous  
claims, c h a r a c t e r i z e d in that the guiding means  
(5") has a guiding groove (9").

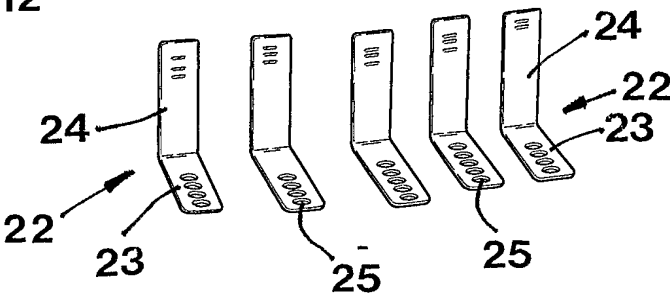
***Fig 1***



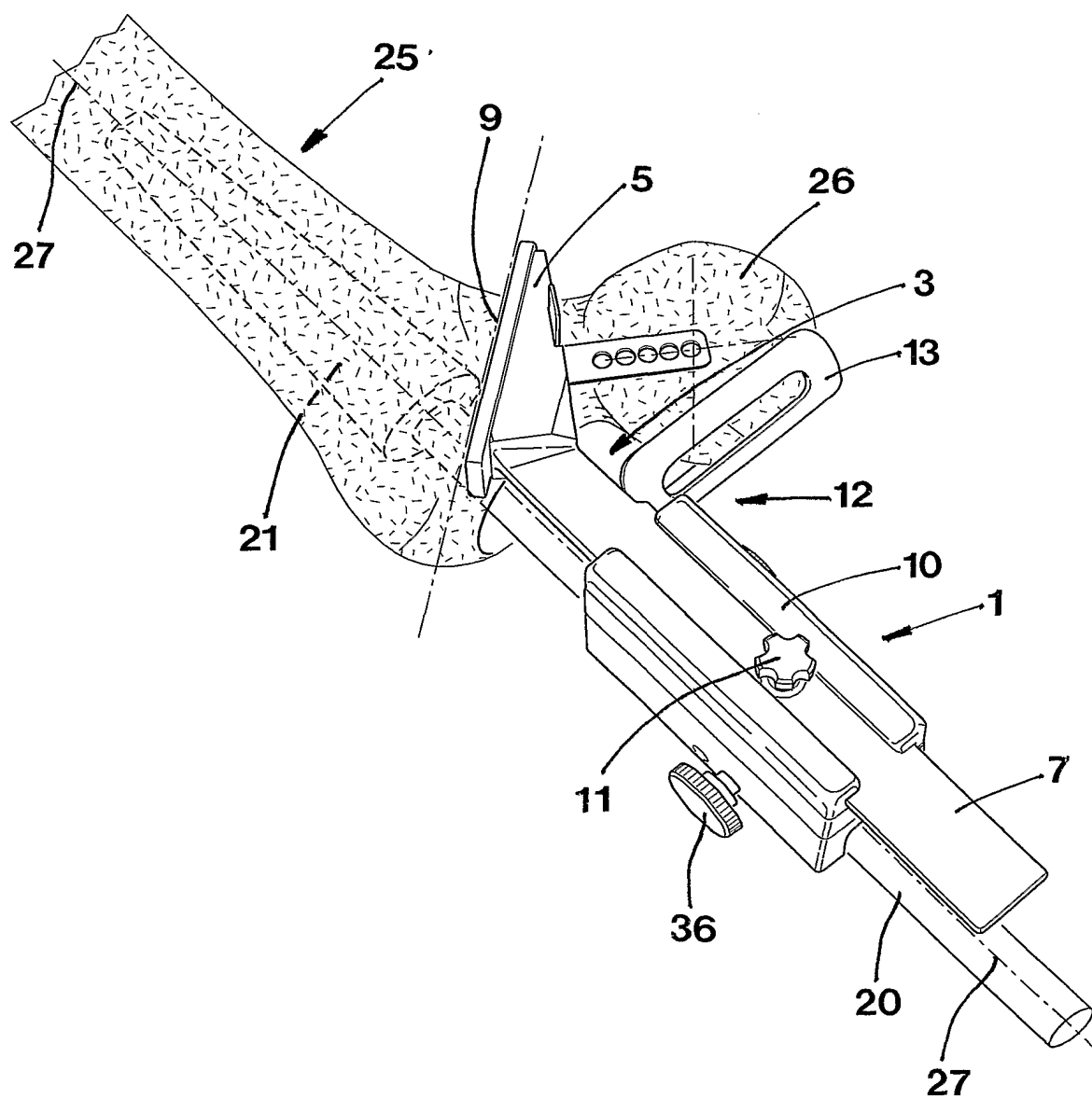
***Fig 2***



***Fig 3***

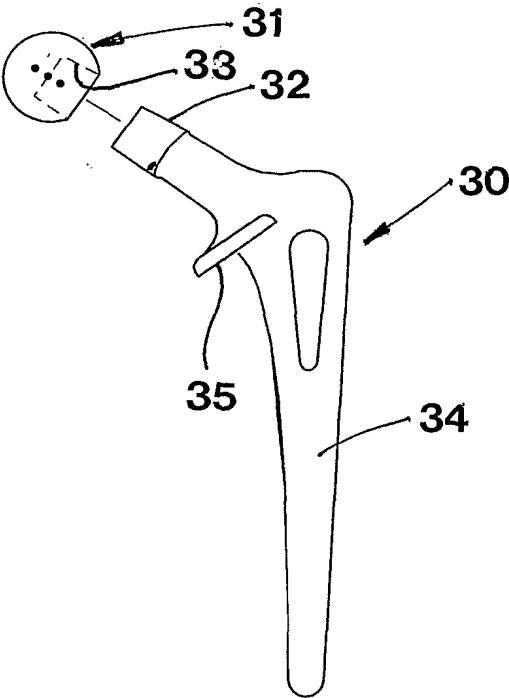


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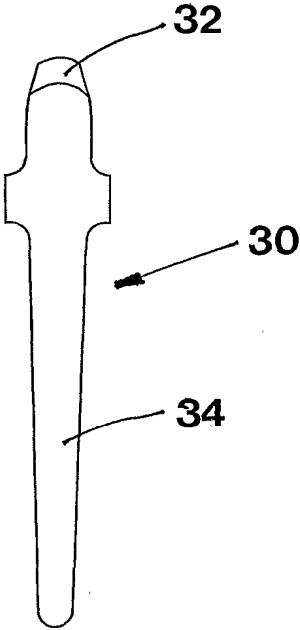
**Fig 4**



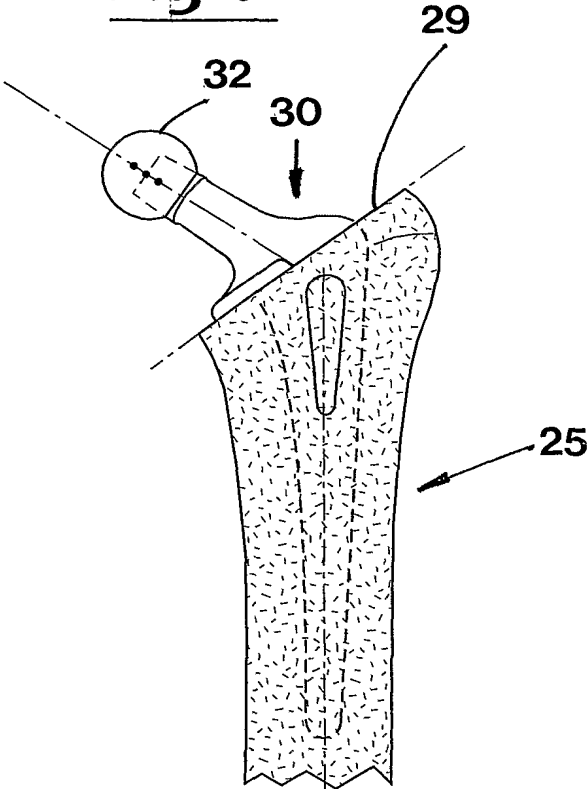
**Fig 5**



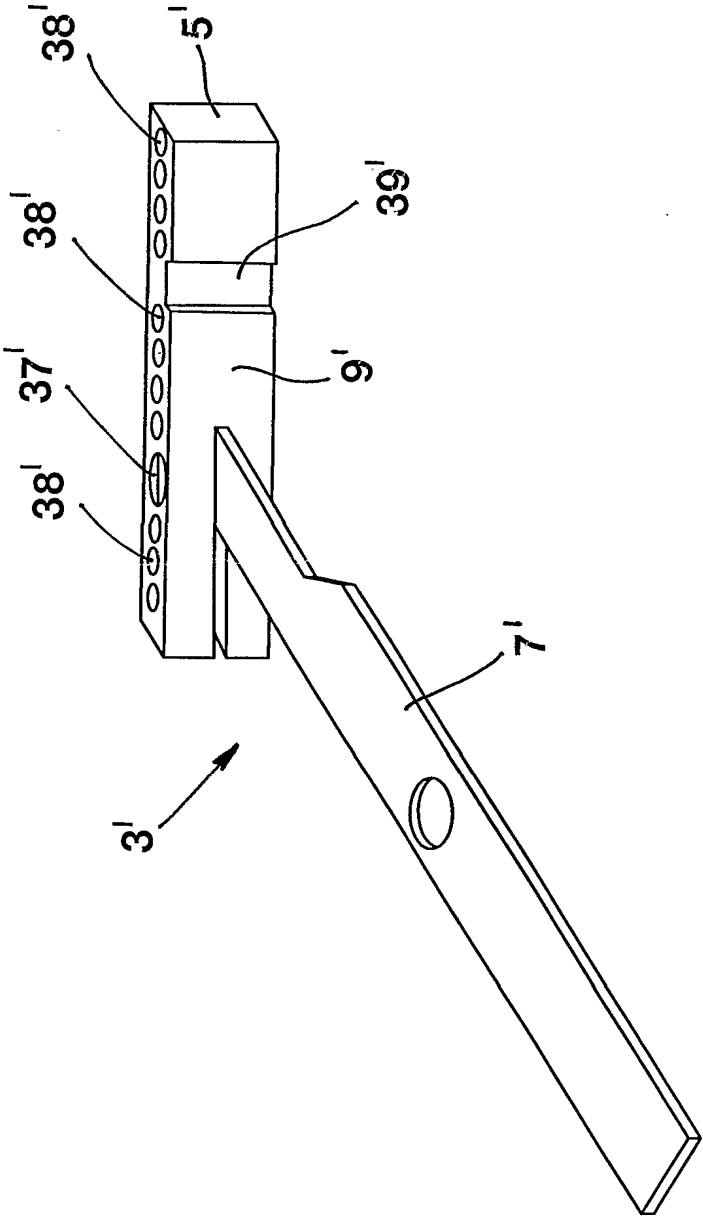
**Fig 6**



**Fig 7**



**Fig 8**





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 01/02052

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A61B 17/74, A61B 17/15

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5578037 A (SANDERS ET AL), 26 November 1996 (26.11.96), abstract, figures --	1-10
A	US 4959066 A (DUNN ET AL), 25 Sept 1990 (25.09.90), abstract, figures --	1-10
A	US 4621630 A (KENNA), 11 November 1986 (11.11.86), abstract, figures --	1-10
A	US 5468243 A (HALPERN), 21 November 1995 (21.11.95), abstract, figures --	1-10

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

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## INTERNATIONAL SEARCH REPORT

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5133766 A (HALPERN), 28 July 1992 (28.07.92), abstract, figures --	1-10
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